July 1998 Highlights of the Pulsed Power Inertial Confinement Fusion Program

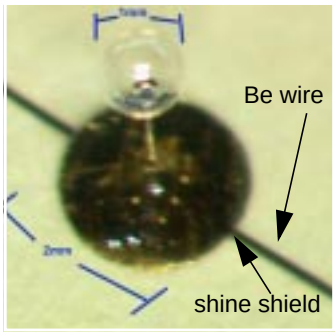

Fig. 1. Capsule on stalk attached to shine shield. Target is tool to diagnose capsule implosion symmetry and evaluate resolution in on-axis hohlraum shots. Be wire serves as mounting hardware inside the hohlraum.

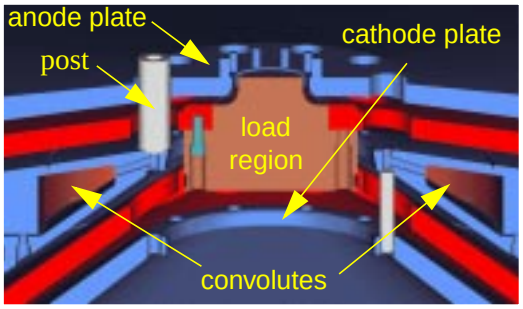

Fig. 2. Vacuum double-post-hole convolute on Z to couple four MITLs to the load.

The August *Scientific American* contains Gerry Yonas's article describing the past and present role of pulsed power in ICF and summarizing the extraordinary progress in z pinches in the last three years and what is needed for high yield. The 18 shots this month included shock physics experiments to evaluate the Z environment for equation-of-state applications, dynamic hohlraum shots with single and nested arrays and with a first attempt to obtain spherical drive, on-axis hohlraum shots, one power flow shot, and one LANL weapons physics shot. The on-axis, static-walled hohlraum experiments used an unfilled plastic capsule mounted on a stalk within a secondary hohlraum (Fig. 1) to begin assessing the symmetry of capsule implosions.

The LLNL Beamlet, operational since 1994 to test laser technologies for the National Ignition Facility, was retired this month. The laser, renamed Z/Beamlet, is being dismantled and shipped to Sandia to create a bright x-ray source on Z experiments that will provide direct images of objects inside a hohlraum. The removal of offices and laboratories from a building adjacent to the Z facility will provide room for the 100-foot-long laser and its auxiliary components. The first test firing of the laser in its new location is expected to be next summer.

We are evaluating three-dimensional, electromagnetic particle-in-cell (PIC) codes such as QUICKSILVER and LSP to decide how computational tools should be improved to optimize vacuum power flow in X-1. The vacuum power flow design for Z, which has a conductor geometry that joins ("convolutes") four magnetically insulated transmission lines (MITLs) into a single MITL terminating at the load (Fig. 2), was done mainly on 2D PIC codes; for X-1, we will use a fast, accurate, flexible, and modular 3D code. Much data is now available from Z experiments to validate 3D code enhancements such as realistic geometries and boundary conditions, including surface plasmas produced by z-pinch radiation illuminating the MITLs. We used the Mission Research code LSP to confirm our empirical observation that Bdot current monitors should be placed in the load region just downstream of the post in order to minimize electron damage. We are implementing a major improvement in QUICKSILVER using meshes that conform with the actual geometry to be simulated rather than conforming to the rectangular grid of the code, which has forced the slanted MITL surfaces to be modeled as stairsteps. The new procedure, based on the VOLMAX code, interfaces a tetrahedral grid to a rectangular grid without spatial interpolation.

Neutron diagnostics are being readied for two types of experiments on Z, in August and October, that will generate neutrons from an on-axis CD_2 fiber inside a wire array and from an exploding pusher target filled with cryogenic D_2. The diagnostics include indium activation, plastic scintillators, bubble detectors, CR-39 film, and neutron time-of-flight detectors. Some of these diagnostics are also sensitive to energetic photons (gamma rays), so selective attenuation schemes have been developed to distinguish photon-generated from thermonuclear neutrons.

July visitors included Malcolm Haines, Raul Aliaga-Rossel, and Jeremy Chittenden of Imperial College and Dale Meade of Princeton Plasma Physics Laboratory. Malcolm has improved his heuristic model of imploding wire arrays. Jeremy is using a 3D resistive magneto-hydrodynamic (MHD) code to model the long-pulse Saturn experiments and the MAGPIE experiments at Imperial College with 8 to 64 Al wires. For the first time, Raul has measured the azimuthal structure of the plasma between the imploding wires vs time end on by laser interferometry. Dale discussed collaboration with Princeton on magnetic hydrodynamics and MHD code development.

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